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Surgeons' Concern and Practices of Protection Against Bloodborne Pathogens

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Objective
To evaluate surgeons' concern regarding risk awareness and behavioral methods of protection against bloodborne pathogen transmission during surgery.

Methods
A 29-item questionnaire was sent to 914 surgeons from two universities and two surgical societies.

Results
The questionnaire was returned by 768 active surgeons. Slight or moderate concern about contracting human immunodeficiency virus (HIV) was reported by most surgeons; 8% reported extreme concern and 4% reported no concern. In total, 605 surgeons reported having been vaccinated against hepatitis B; surgeons in practice <7 years were most likely to be vaccinated. Most surgeons did not routinely use double gloves: 92 of 768 surgeons reported that they always use double gloves when performing surgery, and 83 reported that they usually use double gloves. There was a statistically significantly higher proportion of surgeons who always or usually use double gloves who also had hepatitis B vaccinations. Most surgeons incorrectly estimated the seroconversion rates with exposure to a patient with HIV (66% incorrect), hepatitis B (88% incorrect), or hepatitis C (84% incorrect). Most surgeons never or rarely report needle-stick injuries, and only 17% always report needle-stick injuries.

Conclusions
Most surgeons underestimate the risk of bloodborne pathogens and do not routinely use double gloves.

Surgical technique and protective barriers in the surgical suite were designed to protect the patient from contamination, but in more recent years there has been increased concern regarding patient-to-surgeon transmission of bloodborne diseases.[1–8] Surgical gloves have been used to provide a protective barrier for both surgeon and patient for many years. In 1996, the Centers for Disease Control and Prevention (CDC) reported 52 health care workers with documented human immunodeficiency virus (HIV) seroconversion after occupational exposure.[9] Fear of transmission of bloodborne diseases such as hepatitis and HIV has caused many people to reevaluate the effectiveness of gloves for protection and to evaluate other strategies of protection against bloodborne pathogens. The purpose of this study was to evaluate surgeons' concern regarding risk awareness and behavioral methods of protection against bloodborne pathogen transmission.

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METHODS

Questionnaire

A 29-item questionnaire concerning risk of transmission, awareness of seroconversion rates, double glove practices, and reporting patterns of needle-stick injuries was developed (Appendix 1). Questions regarding the use of protective eyewear were not included. After approval of the Human Studies Committee at Washington University School of Medicine, St. Louis, Missouri, mailing lists were compiled from two universities and two surgical societies.

Subject Sample

In June 1995, questionnaires were mailed to 914 surgeons from Washington University School of Medicine, the Uni-

versity of Toronto Medical School, the Plastic Surgery Research Council, and the General Thoracic Surgical Club. The first mailing included a cover letter with the questionnaire; if the questionnaire was not returned, a second copy was sent. Those who did not respond to the second mailing were contacted by telephone or fax.

Data Analysis

Demographic data and frequency tables were compiled from the returned questionnaires. The relations between universities and specialties and concern about risk of transmission, double glove practices, hepatitis vaccination, and reported needle-stick injuries were evaluated using chi square analysis. The relation between double glove practices and age of surgeons was evaluated using Student's t test analysis. Surgeons who did not respond to a specific question were excluded from that analysis.

RESULTS

In total, 840 questionnaires were returned; 768 were completed by active surgeons and 72 were not completed because of death, retirement, or a change in practice (*i.e.*, the respondent no longer practiced surgery). Therefore, our sample consisted of 768 active surgeons. There were 721 men and 47 women with a mean age was 49 years (SD 10 years; range 31 to 80 years) and a mean time in practice of 16 years (SD 10 years, range 0.5 to 50 years).

HIV Concern

Slight or moderate concern about contracting HIV was reported by most of the surgeons (88%); 8% reported extreme concern and 4% reported no concern. There was more concern expressed by surgeons at Washington University than at the University of Toronto ($p < 0.001$), but there was no statistically significant difference between HIV concern of plastic *versus* thoracic surgeons.

Hepatitis B Vaccination

In total, 605 of 745 surgeons (81%) reported being vaccinated against hepatitis B. There was no statistically significant difference between the number of surgeons with hepatitis B vaccination at Washington University and the University of Toronto. However, there were statistically significantly more plastic surgeons than thoracic surgeons with hepatitis B vaccinations ($p < 0.001$). Those in practice <7 years were more likely to be vaccinated against hepatitis B (94%) than those in practice ≥7 years (76%) ($p < 0.001$).

Double Glove Use

Only 92 of 768 surgeons reported that they always use double gloves, and only 83 surgeons reported that they usually use double gloves (Fig. 1). Of the surgeons who occasionally or rarely use double gloves ($n = 427$), the most important factor for double glove use was patients with active hepatitis or active acquired immunodeficiency syndrome (AIDS) (Table 1). Double glove use was also less frequent in surgeons who reported less concern about HIV transmission ($p < 0.001$) (Fig. 2). Of surgeons who always or usually use double gloves, 31% use the same size for both gloves, 35% use a half-size smaller outer glove than inner glove, and 31% use a half-size larger outer glove than inner glove. Among those who always or usually use double gloves, surgeons reported that it took approximately 1 to 120 days to adapt to using double gloves; the most frequent response was 1 day. Eighty-five percent of surgeons responded that using double gloves decreased hand sensation. However, there were significantly fewer surgeons who routinely used double gloves who reported decreased hand sensation than those who used double gloves less frequently ($p < 0.001$). There was no significant difference in double glove practices between plastic and thoracic surgeons. Significantly more surgeons at Washington University (57%) always or usually use double gloves compared with surgeons at the University of Toronto (31%). The university groups were further subdivided into specialties (general, orthopedics, other), and significantly more orthopedic surgeons reported always using double gloves ($p < 0.001$) than those in other surgical specialties (Fig. 3). Significantly more surgeons in practice <7 years used double gloves ($p < 0.001$). Similarly, age was found to be a statistically significant factor with respect to double glove use. The mean age of those who never, rarely, or occasionally use double gloves was significantly greater than those who usually use double gloves ($p < 0.002$), but no significant difference in the age of those who always use double gloves was found. There was a statistically significantly higher proportion of surgeons who always or usually use double gloves who also had hepatitis B vaccinations ($p < 0.008$) (Fig. 4). A sensitivity to latex gloves was reported by 133 of 743 surgeons.

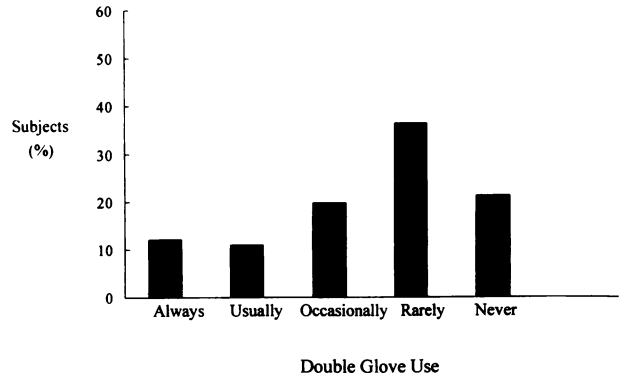

Figure 1. Reported use of double gloves. Only 92 surgeons reported that they always use double gloves. Occasional use was reported by 150 surgeons, and 57% reported that they rarely or never used double gloves.

Table 1. IMPORTANT FACTORS FOR SURGEONS THAT OCCASIONALLY OR RARELY DOUBLE GLOVE

	Degree of Importance (% of Surgeons Who Occasionally or Rarely Use Double Gloves, n = 427)				
Patient Factors	**Extremely Important**	**Very Important**	**Moderately Important**	**Slightly Important**	**Not Important**
Gender	10	9	13	65	3
Race	10	11	14	61	4
Age	11	15	15	56	3
Marital status	11	13	15	57	4
Hospital	13	16	11	57	3
Type of surgery	30	22	14	32	2
Trauma	35	24	14	26	1
IV drug user	78	8	4	10	>1
HIV positive	87	3	1	8	>1
Hepatitis positive	82	5	3	9	>1
AIDS active	88	2	2	8	>1
Hepatitis active	92	3	2	2	>1

Knowledge of Seroconversion Rates

Most surgeons underestimated the seroconversion rates with exposure to a patient with HIV, hepatitis B, or hepatitis C. The correct seroconversion rate with exposure to HIV was identified by only 211 of 418 surgeons. Only 76 of 536 surgeons were correct about hepatitis B seroconversion rates; with hepatitis C, 95 of 489 surgeons were correct in identifying the seroconversion rate. There was no statistically significant relation between reported HIV concern and knowledge of seroconversion rates (HIV, 1/300; hepatitis B, 1/10; hepatitis C, 1/20). There were no statistically significant differences in reported double glove use and knowledge of seroconversion rates (HIV, hepatitis B or C).

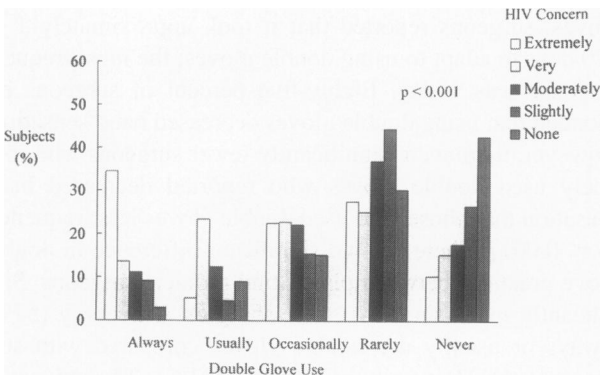

Figure 2. Reported use of double gloves and HIV concern. Surgeons less concerned about HIV were also less likely to use double gloves.

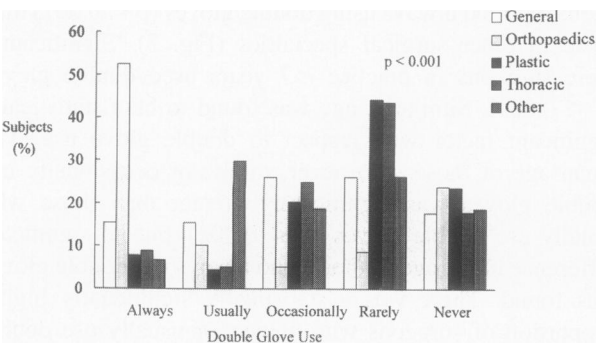

Figure 3. Reported use of double gloves by specialty. Significantly more orthopedic surgeons reported routinely using double gloves than surgeons in other specialties.

Reported Needle-Stick Injuries

Seventy percent of surgeons never or rarely report needle-stick injuries; only 17% always report needle-stick injuries. The mean number of needle sticks over 3 years was 11 (SD 35, median = 4). Most surgeons reported no needle-stick injuries involving HIV-positive patients (94% of surgeons), patients with AIDS (97% of surgeons), and patients with hepatitis B (83% of surgeons). Only 4% of surgeons reported one needle-stick injury involving HIV-positive patients, 2% of surgeons involving patients with AIDS, and 9% of surgeons with hepatitis B patients. More than one

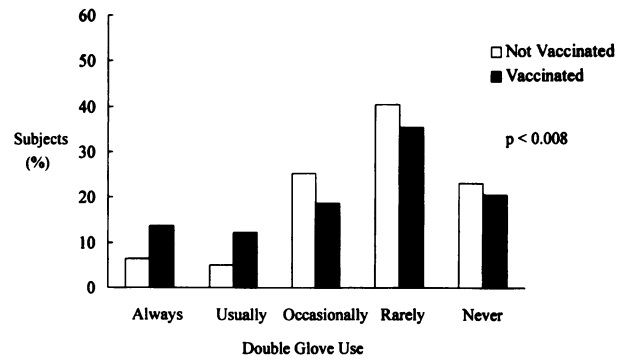

Figure 4. Frequency of double glove use and hepatitis B vaccination. Surgeons who had hepatitis B vaccinations were more likely to use double gloves.

needle-stick injury involving HIV-positive patients was reported by 1% of surgeons, <1% of surgeons involving patients with AIDS, 1% of surgeons involving patients with hepatitis C, and 7% of surgeons involving patients with hepatitis B.

DISCUSSION

Exposure to bloodborne pathogens is common in the surgical suite and has stimulated concern regarding protection against disease transmission.[1,3,7,8,10–12] Protection strategies have included the establishment of universal precautions, the use of double gloves, and hepatitis B vaccination.[1,2,4,6,13–20] Despite the increasing number of high-risk patients, these protection strategies have not been universally accepted by surgeons. Universal precautions are work practice recommendations developed by the CDC to minimize the risk of exposure to blood and other body fluids. Although universal precautions have been shown to reduce exposure, these precautions are not strictly followed.[4,17,21] Hepatitis B vaccinations have been available since 1985, but many surgeons fail to be vaccinated. In our study, 78% of surgeons were vaccinated against hepatitis B, supporting similar reported data.[6,13] However, in our study and in the report by Rhodes,[6] younger surgeons were more likely to be vaccinated; therefore, with attrition through retirement, the percentage of vaccinated surgeons is likely to increase.

Double glove practice was also sporadic: only 12% of surgeons surveyed always used double gloves. Gloves provide an adequate protective barrier, but they can tear or puncture, providing a path of fluid transmission from patient to surgeon and *vice versa*. Therefore, the use of double gloves can increase protection by providing a second barrier.[1,14,18,19]

Although concern regarding bloodborne pathogens was high, the use of protection may be influenced by the perceived risk of transmission. With percutaneous exposure to infected blood, the seroconversion rates for HIV are reported to be 1/300, whereas the seroconversion rates for hepatitis B and hepatitis C are reportedly much higher: 6% to 30% for hepatitis B and 4% to 10% for hepatitis C.[5,10–12,22] Most surgeons in our survey underestimated the seroconversion rates of HIV, hepatitis B, and hepatitis C with exposure to infected blood. Surgeons need to be made aware of the risks of acquiring a bloodborne pathogen with exposure, and methods to reduce the risk. The routine use of double gloves may help to decrease exposure. Although many surgeons do not believe that using double gloves will protect against puncture wounds, double gloves will decrease exposure in case of glove failure or tearing. Fay and Dooher[15] evaluated the barrier effectiveness of surgical gloves. The glove failure rate was up to 16% for specialty gloves and was more frequent in longer procedures (1 to 3 hours, 27% failure rate; 3 to 5 hours, 47% failure rate; >5 hours, 58% failure rate). Gani et al.[16] evaluated the perforation rate in single and double gloves by testing the gloves after surgery by water distention. In the single glove group, the perforation rate was 21%. In the double glove group, only 2.5% perforations were found in both inner and outer gloves. Surgeons, as compared with other surgical personnel, were at the highest risk for glove perforation, and this risk increased with longer procedures. Similarly, Marin-Bertolin et al.[18] reported more perforations in the outer gloves and concluded that using double gloves decreases exposure.

Decreased hand sensation is a concern with the use of double gloves.[23] However, in our study, perception of decreased hand sensation was significantly higher in surgeons who did not routinely use double gloves. Therefore, it may be necessary to progress through an adaptation period of double glove use to develop fine sensory discrimination with double gloves. In most cases, surgeons were able to establish a comfortable technique for double glove use within 2 days, although there were reports of an adaptation time of up to 4 months. In our review, there was fairly equal distribution between using the same size inner and outer glove and a larger or smaller inner or outer glove. The combination probably depends on individual preference. Surgeons and assistants need to be aware of the adjustment process and during the learning phase should be given the opportunity during the procedure to vary glove sizes to establish the most comfortable glove combination.

Reports of needle-stick injury and puncture wounds may be a gross underestimate of the actual incidence of exposure. Our survey supports other reports that surgeons and other health care workers do not usually report these types of injuries.[4,24,25] Knowledge of seroconversion rates and an emphasis on the need for evaluation after exposure may increase the reporting of needle-stick injuries. In the event of a needle-stick injury with contaminated infected blood, the potential usefulness of prophylactic therapy with drugs such as AZT, interferon, or immunoglobulin should encourage the reporting and medical evaluation of all needle-stick injuries. In the surgical suite, these injuries often occur during suturing; therefore, education on correct technique, using only instruments, can decrease the number of digits in the surgical field. Passing the needle back to the assistant with the needle driver clamped to the suture rather than the needle itself is one way to decrease the likelihood of a needle-stick injury. Recommendations for outside the surgical suite have also been proposed, such as not recapping needles after use but simply discarding the used needles into a container for sharp instruments.

Recommendations by the CDC for treatment after exposure to potentially contaminated blood vary with the type of bloodborne pathogen and patient status.[26] In our institution, any health care worker who has been exposed to potentially contaminated blood must report to the occupational health unit or emergency room. A detailed history of the nature of the exposure will be taken; depending on the type of exposure, different protocols may be recommended. If the patient is HIV-positive, then antiretroviral therapy will be

recommended and should be administered within 30 minutes after the needle stick. If the patient has been receiving AZT therapy, the virus may be resistant to standard AZT treatment, then a triple antiretroviral therapy (AZT, lamivudine, and adenovir) will be recommended. With respect to hepatitis B exposure, the status of the health care worker is critical. If the exposed worker has not been vaccinated, then immunoglobulin and a vaccination regimen are started immediately. If the worker has been previously vaccinated against hepatitis B, then blood will be drawn to ensure that antibody levels are appropriate, and immunoglobulin is given. Although there is no standard prophylactic treatment after exposure to hepatitis C, it is necessary to follow the person for evidence of seroconversion. During this 12-month period, care should be taken to protection against transmission to others (*i.e.*, sexual transmission). In the unfortunate event that hepatitis C seroconversion occurs, then the worker should be educated regarding the potential use of interferon or involvement in the new National Institutes of Health trials.

Most surgeons underestimate the risk of contracting a bloodborne pathogen and do not routinely use double gloves. More education regarding the risk of exposure and seroconversion rates may increase compliance with protection against bloodborne pathogens. Senior surgeons should be encouraged to use double gloves and to ensure that those on their surgical teams do so as well.

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APPENDIX

The purpose of this study is to evaluate surgeons' opinions and practices regarding the use of single and double gloves across different surgical specialties. There is the potential for breach of confidentiality and for the protection of your confidentiality, the completed questionnaires will be stored in locked filing cabinets and computer data will be available by password only to the three study investigators. Subjects will not be identified in any presentation or publications resulting from this study.

ID#: _____ Age: _____

Sex: _____ Male _____ Female

Surgical Specialty: _____

Years in Residency: _____ Years in Practice: _____

Average number of hours in O.R. per week: _____ hours

When operating do you double glove?

_____ Always _____ Usually _____ Occasionally

_____ Rarely _____ Never

If you do not always double glove, what are the reasons? (Check all that apply)

_____ No need

_____ Produced hand tingling and/or numbness

_____ Produced hand pain

_____ Decreased hand sensation

_____ Made surgery more difficult

_____ Decreased ability to manipulate tissues and instruments
_____ Other (please explain) _____

When operating, do you ever triple glove?
_____ Always _____ Sometimes
_____ Occasionally _____ Rarely _____ Never

Have you ever tried a period of double gloving?
_____ Yes _____ No _____ Presently Trying
If unsuccessful, how long did you attempt to double glove? _____
Why did you discontinue?
_____ No need
_____ Produced hand tingling and/or numbness
_____ Produced hand pain
_____ Decreased hand sensation
_____ Made surgery more difficult
_____ Decreased ability to manipulate tissues and instruments
_____ Other (please explain) _____

If you were successful in converting to double gloves, how long did it take for you to adapt?
_____ /days _____ /weeks _____ /months
How many different combinations of gloves did you try? _____

How concerned are you about contracting HIV through your work?
_____ Extremely _____ Very _____ Moderately
_____ Slightly _____ No concern

What percentage of your patients do you believe are positive for:
_____ % HIV _____ % Hepatitis

What percentage of your patients do you order blood tests to screen for:
_____ % HIV _____ % Hepatitis

Have you ever been vaccinated against Hepatitis B?
_____ Yes (# of injections _____) _____ No

Do you have any microabrasions or open sores/cracks on your hands or nailbed region?
_____ Always _____ Sometimes
_____ Occasionally _____ Rarely _____ Never

How often do you sustain a needle stick injury?
_____ none _____ /week _____ /month
_____ /year

How often do you report an actual needle stick injury?
_____ Always _____ Sometimes
_____ Occasionally _____ Rarely _____ Never

How many needle stick injuries have you had in the last 3 years? _____

How often do you sustain a skin break from other means in the operating room?
_____ none _____ /week _____ /month
_____ /year

Have you ever been stuck by a needle while treating a patient positive for:
HIV _____ Yes (_____ # of times) _____ No
AIDS _____ Yes (_____ # of times) _____ No
Hepatitis B Yes (_____ # of times) _____ No
Hepatitis C _____ Yes (_____ # of times) _____ No

Secondary to a needle stick injury, have you ever been treated with:
AZT _____ Yes (_____ # of courses) _____ No
Gammaglobulin _____ Yes (_____ # of courses) _____ No

How important are each of these factors in influencing your decision to double glove:

	Extremely Important	Very Important	Moderately Important	Slightly Important	Not Important
1. Patient Gender	4	3	2	1	0
2. Patient Race	4	3	2	1	0
3. Patient Age	4	3	2	1	0
4. Patient Marital Status	4	3	2	1	0
5. Hospital	4	3	2	1	0
6. Type of Surgery	4	3	2	1	0
7. Trauma Case	4	3	2	1	0
8. Patient known IV drug user	4	3	2	1	0
9. Patient known HIV infection	4	3	2	1	0
10. Patient known Hepatitis carrier	4	3	2	1	0
11. Patient active AIDS	4	3	2	1	0
12. Patient active Hepatitis	4	3	2	1	0

What is the serum conversion rate secondary to a needle stick injury from a patient
a) positive for HIV? _____ 1/10 _____ 1/20 _____ 1/50 _____ 1/300 _____ 1/1,000
b) positive for Hepatitis B? _____ 1/10 _____ 1/20 _____ 1/50 _____ 1/300 _____ 1/1,000
c) positive for Hepatitis C? _____ 1/10 _____ 1/20 _____ 1/50 _____ 1/300 _____ 1/1,000

Has anyone you personally know ever
been infected with _____ HIV _____ Hepatitis _____ None
died from _____ AIDS _____ Hepatitis _____ None

Do you believe that operating with double gloves decreases your hand sensation?
_____ Yes _____ No

Do you have any allergic sensitivity to latex gloves?
_____ Yes _____ No

Indicate size and type of glove that you use when operating with single gloves:

	Single Glove (Indicate Size)
White (Triflex)	_____
Brown (Ultraderm)	_____
Yellow (Biogel)	_____
Orthopedic	_____

Other _____

Indicate size and type of glove that you use when operating with double gloves:

	Double Gloves Inner glove (Indicate Size)	Double Gloves Outer glove (Indicate Size)
White (Triflex)	_____	_____
Brown (Ultraderm)	_____	_____
Yellow (Biogel)	_____	_____
Orthopedic	_____	_____
Other _____		